The Sidereal Messenger.

CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory.

AUGUST, 1885.

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"He telleth the number of the stars: He calleth them all by their names."

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CONDUCTED BY WM. W. PAYNE,

Director of Carleton College Observatory, Northfield, Minnesota.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

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ASTRONOMICAL CIPHER MESSAGES.

THE EDITOR.

The work of the practical astronomer requires so much care and time, and so many favoring circumstances to assure accurate results, that progress is slow in almost every direction. For example, it is true that the ready computer can know, in a few hours, the rough path of a comet in cases of rapid apparent motion; but the rigorous and exhaustive study of the motions of these erratic visitors, in general, is the task of years, sometimes of centuries. On this account it is necessary to economize time, to make reasonably certain all efforts to transmit useful astronomical data, and to secure concert of action among astronomers in all parts of the world. A good illustration of the vigorous and pains-taking way in which astronomers work, is found in the cipher code for the distribution of important astronomical news, published at Harvard College Observatory in 1881, and now in general use in this and foreign countries.

The key to the code-book is the revised edition of Worcester's Comprehensive Dictionary, and the manner of its use may be shown by explaining a telegram received at Carleton College Observatory, July 13, at 7 o'clock and 35 minutes in the evening, announcing the orbit and ephemerides of BARNARD's new comet, which was discovered July 7, at Nashville, Tennessee. Omitting date and address, the telegram was as follows:

"Customably, digitated, butternut, border, inspection, evenly, cover, jolter, casuist, jaw, cenatory, irresistibly, changeably, invoke, cherub, interrex, fetter. E. C. PICKERING."

For the meaning of these words reference is made to the dictionary before named, and the number of the page and the number of the word on the page to represent facts to be communicated, as will be easily understood in what follows:

ELEMENTS AND EPHEMERIDES OF BARNARD'S COMET, 1885.

		Page.	Word.		
(1)	Customably	136	73	= May 16, 73, 1885	= Time of Perihelion Passage.
(2)	Digitated	150	8	= 150° 8′	= Distance of Perihelion from node.
(3)	Butternut	91	28	= 91° 28′	= Longitude of node.
(4)	Border	84	27	= 84° 27′	= Inclination to ecliptic.
(5)	Inspection	247	40	= 2.4740	= Perihelion distance.
(6)	Evenly	177	40	= (Control word)	= ¼ of sum of one to 5 inclusive.
(7)	Cover	177	40	= { July 13 .87	= First date of ephemerides. = Light of comet at discovery being 1
(8)	Jolter	257	42	= 17*h* 11*m*	= First right ascension
(9)	Casuist	98	10	= 98° 10′	= First north polar distance.
(10)	Jaw	256	01	= 17*h* 4*m*	= Second right ascension.
(11)	Cenatory	100	23	= 100° 23′	= Second north polar distance.
(12)	Irresistibly	254	27	= 16*h* 58*m*	= Third right ascension.
(13)	Changeably	102	31	= 102° 31′	= Third north polar distance.
(14)	Invoke	253	03	= 16*h* 52*m*	= Fourth right ascension.
(15)	Cherub	104	32	= 104° 32′	= Fourth north polar distance.
(16)	Interrex	250	32	= { July 25 .72	= Last date of Ephemerides. = Light of comet.
(17)	Fetter	188	22.6	= { July 7 2 and 2 or 3	= Date of first observation. = Days of interval between obser.

(1). The 136 means the number of the day of the current year found in the Nautical Almanac. The 73 is the fractional part of the day expressed decimally. The next three numbers explain themselves.

(5). The perihelion distance of a body is usually expressed in terms of the *Earth's* mean distance from the *Sun*, and the code requires that the last four figures be regarded as decimal places. Hence the perihelion of this comet's orbit is about two hundred and twenty-two millions of miles from the *Sun*.

(6). The sixth word is added as a check, and represents one fourth of the sum of the preceding five numbers. It is certain unless two of the six words are wrong.

(7). This word gives two facts. The last three figures (0.87) represents the light of the comet on the first day of the ephemerides, in units of the second decimal place, its light on

the day of discovery being taken as unity. The remaining digits give the day of the month on which the ephemerides began.

The next eight words are the right ascensions and north polar distances for Washington mean midnight at intervals of four days each, July 13, 17, 21 and 25, and (16, interrex,) is a check on these dates which is the 72nd word on the 250th page. Hence, the last date should be July 25, and the theoretical light of the comet ought to be represented by 0.72, showing that the light of the comet is diminishing.

Two curious things were noticed in translating this message. The sixteenth word, 'interrex,' came in the first telegram 'intervex.' The word meant was supposed to be 'intervene' which made the day of the month all right, and the light of the comet 1.07, which seemed possible though not probable. Looking back to word seven, 'cover,' it was found that that word occurred on successive pages, 130, 87 or 131, 1. If 'intervene' was the word, then 131, 1 would give the light on the 13th, 1.01 which might be true although the comet was receding from the *Sun*. To solve this doubt, occasioned by the uncertainty of the sixteenth word and the ambiguity of the seventh, the local operator at this point kindly offered to have the message repeated from Cambridge. In the course of a few hours a second message made the sixteenth word, 'interrex' and the seventh word would then probably be 130, 87, showing a diminution of the light of the comet since the time of discovery. This was a small thing to reverse the fact intended to be given. Usually the cipher code is accurate and very satisfactory so far as we know. This incident given above is unique, and mentioned only on that account.

Ancient Catalogues in Meridian Photometry. An abstract from Part 2, Vol. XVI of the Annals of Harvard College Observatory.

The earliest attempt to obtain accurate information respecting the fixed stars appears to be found in the second book of PTOLEMY'S Almagest. The observations on which this cata-

logue depends are thought to be due chiefly, if not entirely, to HIPPARCHUS, in which case they were made one hundred and fifty years before the Christian era. It is known that HIPPARCHUS made a catalogue referred to the ecliptic which contained 1080 stars. The epoch of PTOLEMY's catalogue, which he said depended on his own observations, was A. D. 138. It has an assumed constant of 36″ a year, and contains 1028.

It is a curious fact that the longitudes of this catalogue, with the above constant, agree fairly well with the true places of the stars, when referred to the time of HIPPARCHUS, but not so well when reduced to the epoch of PTOLEMY.

DELAMBRE thinks that the places of this catalogue are simply those of HIPPARCHUS brought forward.

Dr. PETERS suggests that the large systematic errors of the catalogue may be due to the use of the astrolabe in taking observations on reference objects near the horizon, and, later, neglecting the difference for refraction for greater altitudes.

PTOLEMY's places are now chiefly used to identify stars and assist in the study of magnitudes which were then six in number, as the stars are classified at the present time. Stars that were between the standards in brightness were said to be somewhat fainter than one, or somewhat brighter than another. The most important of these manuscripts is one belonging to the ninth century; it is number 5389 of the collection in the *Bibliotheque Nationale* of Paris.

A valuable revision of the magnitudes by PTOLEMY, or his predecessors, was undertaken in the tenth century by the Persian astronomer, ABDAL-RAHMAN AL-SUFI, whose work is now known through SCHJELLERUP's translation. SUFI re-observed the stars of PTOLEMY's catalogue, and also gave the magnitudes of some other stars, the position of which he indicated by description and by estimates of distance. He adopted the expedient of numbering the stars of each constellation to designate those given in PTOLEMY's catalogue, and he gave much information, useful in identifying them, as well as that which pertained to the astronomical nomenclature of the Arabs. To reduce PTOLEMY's stars to his own epoch (A. D. 964) his cor-

rection was 12° 42′ in longitude, assuming a precession of one degree in sixty-six years. Vol. IX of the *Annals* of the Observatory of Harvard College contains a full discussion of the catalogues of PTOLEMY and SUFI by Mr. C. S. PIERCE, which may be consulted for further details. In Vol. XIII of the Memoirs of the Royal Astronomical Society, BAILY has identified most of PTOLEMY's stars with certainity. SUFI's descriptions of the stars re-observed by him helps to interpret PTOLEMY, and SCHJELLERUP's introduction to the work of the former observer should not be overlooked. When BAILY and SCHJELLERUP differ, the ordinary assumption is, that SUFI's identification of PTOLEMY's stars is correct. There are many cases of this kind which cannot readily be explained.

Other difficulties arise from the different ways in which the same star has been since designated. For northern stars BAILY employs the FLAMSTEED numbers and BAYER's letters. For the southern stars he frequently uses numbers from LACAILLE's *Cœlum Australe Stelliferum*, now a rare work. The Paramatta catalogue, however, has a column for these numbers, and has proved servicable in identifying many stars. The column of magnitudes from the *Uranomatrea Nova*, which SCHJELLERUP gives for comparison with the magnitudes of PTOLEMY and of SUFI is occasionally useful in determining uncertain stars.

Part 2, Vol. XIV of the *Annals* of Harvard College Observatory has a table beginning on page 333 which contains all the stars whose identification is doubtful. The table is fully explained by accompanying remarks.

The catalogue of the Mongol astronomer, OLUG BEG, for the epoch of A. D. 1437 was compiled from original observations of the places of the stars it contains, but the magnitudes are professedly from SUFI's catalogue. Dr. C. H. F. PETERS shows in the *Astronomische Nachrichten*, number 99, that these two catalogues clearly agree. Their differences are given in the *Annals* above referred to.

After the rejection of stars of doubtful places, there are 757 of PTOLEMY's stars and 830 of SUFI's which seemed to be well enough identified, and suitably placed, to be used in determining

the scales of magnitude of the ancient catalogues by the meridian photometer at Harvard College Observatory. The first step in this process was to find the mean photometric magnitude of each group of stars to all of which PTOLEMY or SUFI had applied the same designation in the northern, southern and zodiacal constellations. As the work progressed it was soon found that no such systematic differences appeared, in the comparison of the northern, southern and zodiacal stars, as to require a separate determination of the scale of magnitude for each of these classes, nor was it thought best to determine scales for intermediate magnitudes, the six entire consecvtive numbers being deemed sufficient.

The next step in the study of the magnitudes of the stars of these ancient catalogues was to take these entire magnitudes as abscissas, and the corresponding photometric means as ordinates, and plot a series of points for each catalogue and then draw a smooth curve through them, and the abscissas of points on this curve having photometric means as ordinates were then found, which result was the magnitude sought. It is interesting to notice that the photometric magnitudes of the entire number rarely differ one tenth from those found in the old catalogues.

In a manner altogether similar to that just considered, the study of intermediate magnitudes to tenths has been undertaken, and with the following results in regard to PTOLEMY: It has been found that 1.65 is the equivalent of 1.2; similarly that 2.50 is equivalent to 2.3; 3.23 to 3.4, and 4.49 to 4.5. The mean of the four fractional values, .65, .50, .23 and .49 is .47 but if we give these values weights proportional to the number of stars in each group, the mean becomes .39 which was the value adopted. In plotting the points in this work, the entire magnitudes were used as abscissas of points on the curve already drawn, and the corresponding ordinates were taken as the resulting values of the several sub-divisions of magnitude on the photometric scale.

What has been said indicates the points of interest, shown, in the best of the old star eatalogues, and how they are being

used to make the photometric standards of magnitude at Harvard College Observatory. This is a most important work in stellar astronomy, and it is to be hoped that nothing will interfere to retard it until it is speedily completed. Next we will notice the catalogues of Sir WILLIAM and Sir JOHN HERSCHEL, and others later. [EDITOR.]

ON THE SOLAR CORONA.

BY DR. WILLIAM HUGGINS.

(Concluded from last month.)

It has been suggested, even, that the corona is so complex a phenomenon that there may be an element of truth in every one of these hypotheses. Any way this enumeration of hypotheses, more or less mutually destructive, shows how great is the difficulty of explaining the appearances which present themselves at a total solar eclipse, and how little we really know about the corona.

An American philosopher, Professor HASTINGS, has revived a prior and altogether revolutionary question: Has the corona an objective existence? Is it anything more than an optical appearance depending upon diffraction? Professor HASTINGS has based his revival of this long discarded negative theory upon the behaviour of a coronal line which he saw, in his spectroscope, change in length east and west of the sun during the progress of the eclipse at Caroline Island. His view appears to rest on the negative foundation that FRESNEL's theory of diffraction may not apply in the case of a total eclipse, and that at such great distances there is a possibility that the interior of the shadow might not be entirely dark, and so to an observer might cause the appearance of a bright fringe around the moon.*

* Report of the Eclipse Expedition to Caroline Island, May 1883. Memoir of the National Academy of Sciences, Washington.

Not to speak of the recent evidence of the reality of the corona from the photographs which have been taken when there is no intervening moon to produce diffraction, there is the adverse evidence afforded by the peculiar spectra of different parts of the corona and by the complicated and distinctly peculiar structure seen in the photographs taken at eclipses. The crucial test of this theory appears to be, that if it be true, then the corona would be much wider on the side where the sun's limb is least deeply covered, that is to say, the corona would alter in width on the two sides during the progress of the eclipse. Not to refer to former eclipses where photographs taken at different times, and even at different places have been found to agree, the photographs taken during the eclipse at Caroline Island show no such changes. M. JANSSEN says: Les formes de la couronne ont ete absolument fixes pendant toute la duree de la totalite." The photographs taken by Messrs. LAWRENCE and WOODS also go to show that the corona suffered no such alterations in width or form as would be required by Professor HASTING's theory during the passage of the moon.

We have, therefore, I venture to think, a right to believe in an objective reality of some sort about the sun corresponding to the appearance which the corona presents to us. At the same time some very small part of what we see must be due to a scattering of the coronal light itself by our air, but the amount of this scattered light over the corona must be less than what is seen over the dark moon.

That the sun is surrounded by a true gaseous atmosphere of relatively limited extent there can be little doubt, but many considerations forbid us to think of an atmosphere which rises to a height which can afford any explanation of the corona, which streams several hundred thousand miles above the photosphere. For example, a gas at that height, if hundreds or even thousands of times lighter than hydrogen, would have more than metallic density near the sun's surface, a state of things

which spectroscopic and other observations show is not the case. The corona does not exhibit the rapid condensation towards the sun's limb which such an atmosphere would present, especially when we take into account the effect of perspective in increasing the apparent brightness of the lower regions of the corona. There is, too, the circumstance that comets have passed through the upper part of the corona without being burnt up, or even sensibly losing velocity.

There can scarcely be doubt that matter is present about the sun wherever the corona extends, and further that this matter is in the form of a fog. But there are fogs and fogs. The air we breathe, when apparently pure, stands revealed as a dense swarming of million of motes if a sunbeam passes through it. Even such a fog is out of the question. If we conceive of a fog so attenuated that there is only one minute liquid or solid particle in every cubic mile, we should still have matter enough, in all probability, to form a corona. That the coronal matter is of the nature of a fog is shown by the three kinds of light which the corona sends to us. Reflected solar light scattered by particles of matter, solid or liquid, and secondly, light giving a continuous spectrum, which tells us that these solid or liquid particles are incandescent, while the third form of spectrum of bright lines, fainter and varying greatly at different parts of the corona and at different eclipses, show the presence also of light-emitting gas. This gas existing between the particles need not necessarily form a true solar atmosphere which the considerations already mentioned make an almost impossible supposition, for we may well regard this thin gas as carried up with the particles, or even to some extent to be furnished by them under the sun's heat.

It will be better to consider first the probable origin of this coronal matter, and by what means it can find itself at such enormous heights above the sun.

There is another celestial phenomenon, very unlike the corona at first sight, which may furnish us possibly with some

clue to its true nature. The head of a large comet presents us with luminous streamers and rifts and curved rays, which are not so very unlike, on a small scale, some of the appearances which are peculiarly characteristic of the corona.* We do not know for certain the conditions under which these cometary appearances take place, but the hypothesis which seems on the way to become generally accepted, attributes them to electrical disturbances, and especially to a repulsive force acting from the sun, possibly electrical, which varies as the surface and not like gravity as the mass. A force of this nature in the case of highly attenuated matter can easily master the force of gravity, and as we see in the tails of comets, blow away this thin kind of matter to enormous distances in the very teeth of gravity.

If such a force of repulsion is experienced in comets, it may well be that it is also present in the sun's surroundings. If this force be electrical it can only come into play when the sun and the matter subjected to it have electric potentials of the same kind, otherwise the attraction on one side of a particle would equal the repulsion on the other. On this theory, the coronal matter and the sun's surface must both be in the same electrical state, the repelled matter negative if the sun is negative, positive if the sun is positive.

The grandest terrestrial displays of electrical disturbance, as seen in lightning and the aurora, must be of a small order of magnitude as compared with the electrical changes taking place in connection with the ceaseless and fearful activity of the sun's surface, but we do not know how far these actions, or the majority of them, may be in the same electrical direction, or what other conditions there may be, so as to cause the sun's surface to maintain a high electrical state, whether positive or negative. A permanence of electric potential of the same kind would seem to be required by the phenomena of comets' tails.

If such a state of high electric potential at the photosphere

* See "Comets," Royal Institution Proceedings, vol. x, p. 1.

be granted as is required to give rise to the repulsive force which the phenomena of comets appear to indicate, then considering the gaseous irruptions and fiery storms of more than Titanic proportions which are going on without ceasing at the solar surface, it does not go beyond what might well be, to suppose that portions of matter ejected to great heights above the photosphere and often with velocities not far removed from that which would be necessary to set it free from the sun's attraction, and very probably in the same electric state as the photosphere, might so come under this assumed electric repulsion as to be blown upwards and to take on forms such as those seen in the corona; the greatest distances to which the coronal streamers have been traced are small as compared with the extent of the tails of comets, but then the force of gravity which the electrical repulsion would have to overcome near the sun would be enormously greater.

It is in harmony with this view of things that the positions of greatest coronal extension usually correspond with the spot zones where the solar activity is most fervent; and also that a careful examination of the structure of the corona suggests strongly that the forces to which this complex and varying structure is due have their seat in the sun. Matter repelled upwards would rise with the smaller rotational velocity of the photosphere, and lagging behind would give rise to curved forms; besides, the forces of irruption and subsequent electrical repulsion might well vary in direction and not be always strictly radial, and under such circumstances a structure of the character which the corona presents might well result. The sub-permanency of any great characteristic coronal forms, as, for example, the great rift seen in the phorographs of the Caroline Island eclipse and also in those taken in England a month before the eclipse and about a month afterwards, must probably be explained by the maintenance for some time of the conditions upon which the forms depend, and not to an unaltered identity of the coronal matter; the permanency belonging to

the form only, and not to the matter, as in the case of a cloud over a mountain top, or of a flame over the mouth of a volcano. If the forces to which the corona is due have their seat in the sun, the corona would probably rotate with it; but if the corona is produced by conditions external to the sun, then the corona might not be carried round with the sun.

We have seen that the corona consists probably of a sort of incandescent fog, which at the same time scatters to us the photospheric light. Now we must bear in mind the very different behaviour of a gas, and of liquid or solid particles in the near neighborhood of the sun. A gas need not be greatly heated, even when near the sun, by the radiated energy; heated gas from the photosphere would rapidly lose heat; but on the other hand liquid or solid particles, whether originally carried up as such, or subsequently formed by condensation, would absorb the sun's heat, and at coronal distances would soon rise to a temperature not very greatly inferior to that of the photosphere. The gas which the spectroscope shows to exist along with the incandescent particles of the coronal stuff, may therefore have been carried up as gas, or have been in part distilled from the coronal particles under the enormous radiation to which they are exposed. Such a view would not be out of harmony with the very different heights to which different bright lines may be traced at different parts of the corona and at different eclipses. For obvious reasons, gases of different vapour density would be differently acted upon by a repulsive force which varies as the surface and would to some extent be winnowed from each other; the lighter the gas the more completely would it come under the sway of repulsion, and so would be carried to a greater height than the gas more strongly held down by gravity. The relative proportions, at different heights of the corona, of the gases which the spectroscope shows to exist there (and recently Captain ABNEY and Professor SCHUSTER have shown that in addition to the bright lines already known, the spectrum of the corona of 1882 gave the

rythmical group of the ultra-violet lines of hydrogen which are characteristic of the photographic spectra of the white stars, and some other lines also) would vary from time to time, and depend in part upon the varying state of activity of the photosphere, and so probably establish a connection with the spectra of the prominences. This view of the corona would bring it within the charmed circle of inter-action, which seems to obtain among the phenomena of sun-spots and terrestial magnetic disturbances and auroræ.

Many questions remain unconsidered; among others, whether the light emitted by the gaseous part of the corona is due directly to the sun's heat, or to electrical discharges taking place in it of the nature of the aurora. Further, what becomes of the coronal matter on the theory which has been suggested? Is it permanently carried away from the sun, as the matter of the tails of comets is lost to them? Among other considerations it may be mentioned that electric repulsion can maintain its sway only so long as the repelled particle remains in the same electrical state; if through electric discharges it ceases to maintain the electric potential it possessed, the repulsion has no more power over it, and gravity will be no longer mastered. If, when this takes place, the particle is not moving away with a velocity sufficiently great to carry it from the sun, the particle will return to the sun. Of course, if the effect of any electric discharges or other conditions has been to change the potential of the particle from positive to negative, or the reverse, as the case may be, then the repulsion would be changed into an attraction acting in the same direction as gravity. In Mr. WESLEY's drawings of the corona, especially in those of the eclipse of 1871, the longer rays or streamers appear not to end, but to be lost in increasing faintness and diffusion, but certain of the shorter rays are seen to turn round and to descend to the sun.*

* For a history of opinion of the nature of the corona, see Papers by Prof. NORTON, Prof. YOUNG, and Prof. LANGLEY in the '*American Journal of Science*'; also 'The Sun,' by Prof. YOUNG; and 'The Sun, the Ruler of the Planetary System,' and various essays by Mr. R. A. PROCTOR.

It is difficult for us living in dense air to conceive of the state of attenuation probably present in the outer parts of the corona. Mr. JOHNSTONE STONEY has calculated that more than twenty figures are needed to express the number of molecules in a cubic centimetre of ordinary air, and Mr. CROOKES shows us in his tubes that matter, even when reduced to one-millionth part of the density of ordinary air, can become luminous under electrical excitement. [A glass bulb about 4 inches in diameter, kindly lent to me by Mr. CROOKES, was exhibited, in which a metal ball about half an inch in diameter formed the negative pole. Under a suitable condition of the induction current, this ball was seen to be surrounded by a corona of bluish-grey light which was sufficiently bright to be seen from all parts of the theatre.] Yet it is probable that these tubes must be looked upon as crowded cities of molecules as compared with the sparse molecular population of the great coronal wastes.

I forbear to speculate further, as we may expect more information as to the state of things in the corona from the daily photographs which will be shortly commenced at the Cape Good Hope by Mr. RAY WOODS under the direction of Dr. GILL.

Curious, Difficult and Remarkable Nebulæ Discovered at the Warner Observatory, by Dr. LEWIS SWIFT.

I have just sent to the A. N., for publication, the first installment of new nebulæ discovered at this observatory, which, as others already found will soon follow, will be known as Catalogue No. 1. It contains approximate positions with descriptive remarks of 120 new nebulæ. I make a specialty of nebula-work, and, it is not surprising that among the two hundred and fifty *novæ* found, some of them possess characteristics worthy of mention in the SIDEREAL MESSENGER.

When we reflect how thoroughly, during the last hundred years, the sky has been searched over by seekers after comets,

nebulæ, double-stars, etc., it would seem that in the heavens, and, more especially, north of 40° south declination, there could be hardly a single undiscovered nebula as bright as HERSCHEL'S Class II, and yet one is often found, visible even with small telescopes, and which is generally picked up by comet-seekers. On the evening of June 23rd, while testing the performance of a new periscopic eye-piece by GUNDLACH for nebula-work, in presence of a nearly full moon, I observed with my 16-inch refractor a nebulous object which I soon found was either a *nova* or a comet. No motion was detected in twenty-four hours and it was thereby shown to be a nebula. To see a nebula in presence of the moon, largely gibbous, and without previous knowledge of its existence, no matter how large a telescope may be used, bespeaks a pretty bright one. Subsequently, consulting BURRITT'S Star Atlas, whereon I had marked the positions of all nebulæ ever seen with my 4½-inch telescope, I found the same object recorded as follows: "Can find no record of it." This was seven years ago. Its approximate position is R. A. 14*h* 33*m* 35*s*; Dec. +52° 3′ 54″. Described as B. ps. R. p DM. +52° 1816 by 31*s*. I have had several such experiences as the above. All of BARNARD'S nebulæ come under this category of unknown nebulæ being found with small telescopes while comet-seeking.

In *Cepheus* is a remarkable object — G. C. 4634=H IV 74. R. A. 21*h* 3*m* 6*s*; Dec. +67° 27′ 16″, a seventh magnitude star exactly in the center of a large, round, evenly bright nebulous atmosphere. These bodies are called nebulous stars. The entire heavens afford but a few specimens of this variety of the neb ulæ as classified by Sir WILLIAM HERSCHEL, and they should form a distinct class from those in which the star is not centrally placed, and presumably are stars that happen to be situated in our line of sight with the nebula, but probably far this side of the nebula itself, and with which it has no physical connection whatever. I have added three to the number of this variety of nebulous stars. One is in R. A. 6*h* 26*m*

36*s*; Dec. +10° 23′ 15″. It follows G. C. 1425 by 28*s* and is 10′ north. Another is in 21*h* 30*m* 45*s*; +12° 15′ 54″. Our *Sun* is supposed by many astronomers to be one of this class of objects, which, seen from a planet belonging to another sun, would exhibit the appearance of a nebulous star surrounded with a luminous atmosphere which we call the Zodiacal Light. The third and last object of this kind, found in my Catalogue, is the most wonderful of all — in fact is the only instance known to me —for instead of the central star being single, it is double. This was discovered last Friday evening (July 10). Soon afterward, in making a second examination of it, I saw, 5′ north, another large nebula having also a double-star in the center, but this belongs to the other class (optically nebulous) and, though extensive, is far less interesting than the one just previously described. The stars in the former are of the eighth magnitude and distant about 20″. Those of the latter are also 20″ apart, but are very unequal as to magnitude.

I have on several occasions studied the great nebulæ which in their conspicuous brightness have frequently been the subjects of the draftman's pencil, viz: the great nebula in *Orion*, in *Andromeda*, the Hunting Dogs, etc., as well as the *Swan* and the trifid nebulæ, and yet only one of them—the great nebula in *Andromeda*,—appears to me to be correctly illustrated. The drawing of this by Bond, is, in every essential detail, exactly as I see it with the great telescope of the Warner observatory. When the difficulties attaching to such illustrations are considered, the indifferent results are not surprising.

A few evenings since on an exceptionally fine night I made an attack on the trifid nebula, R. A. 17*h* 55*m* Dec.—23° 2′ hoping that the telescope would reveal some new features not before observed. I was pleased to find that a new eye-piece, with a power of 132, and the astonishingly large field of 33′, opened up a series of interesting and beautiful appearances which I was not prepared to see. It is quite impossible to give a faithful description of what a 16-inch refractor equipped with a proper

eye-piece reveals in an object so bright, so extensive and so full of details as this. It, as its name indicates, is broken into three portions by dark rifts or cracks extending from its center, in which is a triple star, to its circumference. This triple star is, as Sir J. HERSCHEL expresses it, "Where three ways meet." The crack or black yawning canyon between the *s. f.* and *n. p.* triads has, by all observers, always been seen without nebulosity, and thus it has hitherto appeared to me, but on this last occasion I saw a feature which I think is new. It is a bridge across the chasm, a thread of light of the most delicate structure extending from wall to wall, but so faint that a large telescope, a trained and sensitive eye and exquisite seeing are necessary for its revelation. The large nebula close north, discovered by MASON & SMITH, was very conspicuous.

To my extreme surprise I detected still another very large nebula close following the trifid, which, strange to say, is also trifid in character, having a branch or prong extending to, and mingling with, MASON & SMITH's nebula.

Taking all things into account, its internal structure and external surroundings, it seems to me, that the trifid nebula is the most interesting one visible from this latitude.

Warner Observatory, July 16, 1885.

METEOR OBSERVATIONS.

WILLIAM R. BROOKS.

A very fine meteor was observed here on the evening of July 6th, about eleven o'clock. My eye was at the telescope at the time of its first apparition. Removing my eye and looking quickly upwards, I beheld the meteor just southeast of the zenith and moving rapidly towards the northwest. At an altitude of forty degrees it exploded into several balls of different colors, the most notable being green and crimson. The foremost ball was an intense crimson, and just preceding that was a brilliant, sharply defined halo. The light of the meteor

brightly illuminated the landscape, and altogether it was a fine spectacle. I listened some time for the report of the explosion, but none was heard. The meteor was witnessed by several persons at this place, also as I heard, the next day, in surrounding towns, including Rochester, 40 miles west of here. It was described there as coming from east to west and brilliantly illuminating the streets of the city.

On the morning of July 8th, about 2 o'clock, another magnificent meteor was seen while resting my eyes from the telescope. This one moved from east to west across the northern heavens below *Polaris.* It left a bright train, visible several minutes, and in the telescope which I turned upon it, was seen to twist and roll in the most curious and interesting manner.

Red House Observatory,
July 15th, 1885.

THE SUNSET GLOW.

Very little can be said of the sunset glow, and the concomitant solar halo that would interest any but the few who still watch steadily the faded glories of the first and the persistent uniformity of the second.

The solar halo, as seen during the past six months, is unchanged, except that it appears broader and shades off at the borders more gradually. Though the sky seem clear of haze, may be enough of it to diminish or destroy the visibility of this halo. When the *Sun* is hidden by a cumulus cloud, clear spaces for 20° around, often show a decided salmon color, instead of the dingy red as usual.

From the records of sunsets, it would be difficult to make any general statement. The idea of variability in the phenomenon itself, independent of atmospheric modifications, sometimes seems plausible. On some clear days, when the solar halo was very prominent, the sunset color was entirely absent. Sometimes when we have had a clear, cool air following a finished precipitation, the sunset or sunrise has been deeply red.

Morning or evening the glow disappears quickly, showing ing that if dust be the cause its altitude is not great.

Last year I noticed on several occasions a wider colored space along the horizon southward from the sunset point than was apparent towards the north. In March of this year the same peculiarity was seen, once toward the south, and twice to the north. Last year Mr. EADIE, of Bayonne, N. J., also observed the same thing. These facts should receive attention.

For eighteen months there had been an unusual glare in the field of the telescope while observing bright planets, or first magnitude stars. The cause of this was thought to be the "material" in the atmosphere which has this year quite disappeared. But the difficulty of seeing second and third magnitude stars in day-time still continues. Is this trouble to the observer due to some highly illuminated "material" in the atmosphere, or to some other cause? J. R. H.

COMET BARNARD, 1885

E. E. BARNARD.

While seeking for comets during my regular zone sweeping, on the night of July 7, at about one hour after midnight, I found an object that struck me at once as unfamiliar. It was in the field with, and *n. f.*, the naked-eye star *δ Ophiuchi* which is Yarnall 7244. I knew of a nebula in about the place occupied by the object that I had seen a number of times during my former sweeps. It is G. C. 4301, discovered by WINNECKE in 1860, but from my remembrance of that nebula it was larger and more diffuse than the object now present. I endeavored to get a glimpse of the nebula, but could not be certain of seeing it, the air being full of dew and the field milky, and wet clouds continually forming in the western sky. However, I thought I detected it but could not be certain that it was not diffused light from three or four small stars that preceded the place of the nebula. Even when I turned the 6-inch equatorial on it I

was no better off, as the sky was considerably thickened. I followed the suspicious object for fully an hour, it becoming fainter and more indefinite all the time. A comparison with δ *Ophiuchi* gave its place:

R. A. 17*h* 21*m* 24*s*; Decl. 4° 57′ 18″ south, at 14*h* 35*m* 37*s*, Nashville mean time.

While watching for motion, I was positive of a perceptible change in a south-westerly direction. However, not being certain of seeing the nebula at the same time, I concluded it would not be well to announce positively the cometary character of the object, until the following night had confirmed my suspicion of a change.

On the morning of the 8th, I at once notified Professor SWIFT of what I strongly suspected was a comet. The object was rather small and ill-defined, with a tiny brightening or nucleus in the middle. The first glimpse of the eye on the evening of the 8th confirmed the cometary character of the object, it having moved 35′ to the southwest. On the 8th the comet's motion was quite perceptible in a short watch. I secured a number of comparisons with the ring micrometer, but have not yet found the stars used in any catalogue. On this date the nebula G. C. 4301 was easibly visible. It closely follows several small bright stars.

The comet was again observed on the 10th and 13th. On the last date the sky being poor, the comet was difficult to observe on the ring, being very ill-defined and dim.

Professor SWIFT's observation of this comet on the night of July 8th with the WARNER 16-inch glass showed it to be quite a wonderful object. He describes it as being evenly sprinkled over with from fifty to one hundred bright points, resembling in appearance a resolvable nebula. My own observations have enabled me only to make out a small, indefinite nucleus. No tail has, so far, been observed. At best the comet has a very far-away look about it. The discovery was made with the 5-inch Byrne refractor.

VANDERBILT UNIVERSITY OBSERVATORY,
Nashville, Tenn., July, 1885.

SOLAR ECLIPSE, MARCH 16, 1885.

Under date of July 6, Engineer C. W. IRISH, Iowa City, sent the following observations of the eclipse, absence from home preventing earlier preparation:

"The night preceding and the day of the eclipse were very cold and windy. Clouds began to form in the morning hours and increased during the day, and towards evening, in dense masses, they completely covered the sky, the wind blowing a violent gale from the northwest during the time. Mrs. C. W. IRISH read the time for me from a mean time clock. The point of first contact I had well determined beforehand. At 10*h* 33*m* 55*s* A. M. I saw a very small, sharp notch in the *Sun's* disc at estimated point of contact. It was in shape like a very broad-based, flat saw-tooth. One and one-half seconds later (10*h* 33*m* 56.5*s*), I saw that the circular black and serrated edge of the *Moon* was just to be seen, on the solar disc at the same point. In all my experience in such observations, I never saw the air so enterely clear of haze, nor did I ever see such splendid definition of the minutiæ of the sun-spots and faculæ and all other features of the *Sun* and *Moon* visible on that day. The only draw-backs were the tremulous motion of the air caused by the wind, and the intense cold at the time.

I watched the progress of the eclipse until the clouds began to gather thick and fast, which after the middle phase prevented observation except at intervals. A good view was obtained at 1*h* 27*m* 48*s* as the following limb of the *Moon* left a small notch. The clouds finally made uncertain the last contact, which was estimated at 1*h* 27*m* 03.5*s*. Observations are given in 90th meridian time.

PHOTOGRAPHING THE ECLIPSE.

On Monday, March 16th, the sun was partially eclipsed, the maximum obscuration at this point being about seven-tenths. Profs. HOUGH, BURNHAM and the writer made a number of negatives of the phenomenon by means of the great refractor at the Dearborn observatory, Chicago. Mr. Burnham dried a negative

by means of alcohol and made a print from it in a very short time, so that the *Times* was able to illustrate the matter by an excellent cut in the issue of the 17th.

Telescopic lenses are not corrected for photographic purposes, but for vision. The yellow rays form a fine image, but the more active blue and violet rays form an image, or a series of images, further from the object-glass, which, indeed, has been over-corrected. In this case a piece of red glass was inserted in front of the sensitive plate, so as to intercept all but the red rays, which it was hoped would prove sufficiently active, and at the same time form a definite, sharply outlined image. The result fully justified the expectations. The image was as sharp in outline, and the horns of the crescent as finely pointed as if cut with a fine engraver's tool. Two sun-spots were distinctly visible in the negative. It is confidently believed that by this means magnified images can be photographed by means of ordinary refracting telescopes. Experiments in this line will be instituted soon.—*The Practical Photographer.*

It seems at first sight incredible that an occurence of 215 years ago could be reported with but one link between the person who tells you and the actual witness. Such, however, is the fact. The narrator in question was the venerable rector of Bushey (the Rev. W. Falconer) just deceased at the age of eighty-four. He had heard has grandfather (the celebrated Dr. Falconer of Bath) say that he had been told by his grandmother that she could remember being held up to the window to see Halley's comet, which appeared in 1669. She was then six years old. Dr. Falconer, the intervener, was born in 1744, and died in 1824. Assuming him to have been at least six years of age when this story was told him, his grandmother must have been ninety. But the wonder must be increased: for if Dr. Falconer told the story in the last year of his life (1824) to a child of six years it might be passed on to the next century with only one link between the witness and the narrator. After all, we are not so dependent on writing as we sometimes assume ourselves to be.—*Pall Mall Gazette.*

TABLE OF PROPER MOTIONS.

EXPLANATION. The numbers in the table are the proper motions of those of Argelander's 250 proper motion stars whose magnitudes are between 6.0 and 8.9. The means are taken for the stars of each tenth of a magnitude; and also, at the side, for each whole magnitude, 6.0 to 6.9, 7.0 to 7.9, 8.0 to 8.9. The table shows that the proper motions do not diminish as the numerical magnitude increases.

Magnitude	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Means
6	0".23= μ .51 .28 .24 .15 .29 .91 .15 0.12	0"65 .10 .60 .24	0".17 .18 .89 .99	2".36 .39 .48 .30 .74 0.60	0".21 0.30	0".32 .08 .19 .20 .19 .37 .94 .35 .25 .62 0.28	0".44 .19 .50 .85 .64 0.14	0".11 0.69 0.97 1.26 1.43 0.32 .22 .42 .34 .59 .36 0.18	0".24 .26 1.00 .16 .69 .34 .54 .70 .46 0.28	0".36 .20 .15 0.55 7.05 0.37 0.19 1.61 0.36 .39 .29	From 6.0 to 7.0 0"54 [77]
Mean	0".3 (9)	0"54 (4)	0".6 (4)	0".8 (6)	0".3 (2)	0".3 (11)	0".5 (6)	0".5 (12)	0".5 (10)	1".1 (11)	
7	0.47 .20 .72 0.46 1.31 0.34 .83 .56 0.31	0.37 .27 .21 .44 .32 .55 .48 0.62	0.73 .27 .46 .31 .28 .84 0.43	0.82 .41 .63 .31 .28 0.46 4.73 0.88 .30 .27 0.28 1.54 0.18	0.36 .26 .18 0.72 1.17 0.64 .31 .02 .86 0.37	0.73 .40 .33 .47 .86 .25 .71	0.29 .56 .29 .28 .40 0.40 1.10 0.21 0.54	0.38 .13 .27 .47 .58	0.27 .38 .49 0.44 1.43 0.67 0.39	0.62 .15 .46 .49 0.60	From 7.0 to 7.9 0".56 [80]
Mean	0.5 [9]	0.4 [8]	0.5 [7]	0.9 [13]	0.5 [10]	0.5 [7]	0.5 [9]	0.4 [5]	0.6 [7]	0.5 [5]	
8	0.44 .54 .21 .20 .79 .32 .40 .51 .43 .47 0.56	0.52 .14 .67 .87 .39 .31 .87 0.44	2.81 0.64 0.24 1.38 0.47 0.32 0.32 0.44 1.21	0.68 1.97 0.24	0.68 0.48 .51 .27 0.49	0.45 2.24 0.67 2.33 0.25 .45 .64 0.31	0.47 .97 .58 .14 .57 .49 1.20	0.49 4.40 1.38	1.40 0.18	0.16 0.31	From 8.0 to 8.9 0.71 [58]
Mean	0.4 [11]	0.5 [8]	0.9 [9]	1.0 [3]	0.5 [5]	0.9 [8]	0.5 [7]	2.1 [3]	0.8 [2]	0.2 [2]	

EDITORIAL NOTES.

The feature of general interest in astronomical circles during the past month is BARNARD's new comet. A telegram announcing its discovery by E. E. BARNARD, at Vanderbilt University Observatory, was first received from Dr. L. SWIFT of Warner Observatory, July 9. The discovery was also telegraphed, in cipher, on the following day to Carleton College Observatory by Professor E. C. PICKERING of Harvard College Observatory. The second message was delayed twenty-four hours, because the comet's position in the first message was identical with 4301 of *Herchel's General Catalogue.* Other positions were obtained at Cambridge, on the nights of July 10, 11, 12. The following positions are given in *Science Observer Circular*, No. 56:

OBSERVATIONS.

				App. R. A.	App. Decl.	Observer
	d.	*h. m. s.*		*h. m. s.*	° ′ ″	
July	7	21 22 50	Gr. M. T.	17 21 23.53	−4 57 4.0	Barnard.
	9	12 32 47	Camb. M. T.	17 48.29	−6 0 55.6	Pickering.
	10	9 41 20	Camb. M. T.	16 9 25	−6 31 8.0	Searle.
	11	9 20 22	Camb. M. T.	14 19.31	−7 5 0.1	Searle.
	11	9 43 44	Wash. M. T.	14 15	−7 6 18.	
	12	9 27 50	Camb. M. T.	12 28.93	−7 39 29.6	Pickering.
	12	9 44 37	Wash. M. T.	12 26.	−7 40 25.	

Elsewhere in this issue will be found a detailed account of a seveneen word message from Cambridge which gave the orbit and ephemerides of the comet as computed by S. C. Chandler, Jr. from observations of July 7, 9 and 10. The elements of its orbit are as follows:

ELEMENTS.

Time of perihelion passage	= 1885, May 16. 725, G. M. T.
Longitude of perihelion	= 241° 37′
Longitude of pefihelion from node	= 150 8
Longitude of node	= 91 28
Inclination	= 84 26
Perihelion distance	= 2.4740.

C−*O*.

$$\Delta\lambda \cos\beta = +0'.3$$
$$\Delta\beta = -0.1$$

The above elements show a very singular orbit, in its great perihelion distance, combined with great inclination. Professor SWIFT's observations make its coma physically interesting.

A full discussion of the theme, "Small *vs.* Large Telescopes," will appear in September issue.

PROPER MOTION OF LALANDE 16616.

(Communicated by Commodore GEO. E. BELKNAP, U. S. N. Superintendent.)

The proper motion of this star has been deduced by comparing observations of LALANDE, ARGELANDER, ROBINSON's places of 1000 stars observed at Armagh, and Washington Transit Circle observations in the years 1881 and 1882.

The Catalogue places are:

Epoch	R. A.	Decl.
1800.0	8h 17m 16.11s	+51° 17′ 36.″2
1842.0	8 20 22.27	+51 9 21. 8
1870.0	8 22 25.58	+51 2 46. 4
1881.0	8 23 14.38	+51 1 32. 8
1882.0	8 23 18.76	+51 1 21. 35

These observations reduced by precession alone to 1882.0 give

	Date of obs.	Epoch.	R. A.	Decl.
	1800.075	1882.0	8h 23m 19.44s	+51° 1′ 51.″14
	1842.465		19.12	36. 37
	1870.426		18.56	25. 88
	1881.216		18.79	21. 06
	1882.168		18.76	21. 35
Mean	1855.270		8h 23m 18.934s	+51° 1′ 31.″16

Giving these observations equal weight, forming equations by the method of least squares, and denoting by x and y the annual proper motions in right ascension and declination, we obtain $4836.86x = 44.49s$ and $4836.86y = -1750.64''$, whence $x = 0.00920s \pm 0.0013s$, $y = 0.3619'' \pm 0.0048.''$

Applying the values for proper motion and reducing the observations to 1882.0, we have—

	Date of obs.	Epoch	R. A.	Decl.
	1800.075	1882.0	8h 23m 18.69s	+51° 1′ 21.″5
	1842.465	1882.0	18.76	22. 1
	1870.426	1882.0	18.46	21. 8
	1881.216	1882.0	18.79	20. 8
	1882.168	1882.0	18.76	21. 4
Mean			8 23 18.69 ± .0406s	+51 1 21.5 ± .146″

Annual motion in R. A. = $-0.00920s \pm 0.0013s$

Annual motion in Dec. = $-0''.3619 \pm 0''.0048$.

U. S. Naval Observatory
Washington, July 8th, 1885.

EDGAR FRISBY,
Professor of Mathematics, U. S. N.

DARK TRANSIT OF JUPITER'S IV SATELLITE.

At two of the late meetings of the California Academy of Sciences, Professor DAVIDSON, the President, read three papers upon two dark transits of *Jupiter's* IV satellite. The first paper was made up from notes of the observation of May 21st by Mr. CHARLES BURCKHALTER, of Oakland, giving the details of the black image of the IV satellite in transit.

The second paper gives Professor DAVIDSON'S observations of the 7th of June of a similar phenomenon; and the third paper is a mamorandum from Mr. BURCKHALTER'S observation of the same transit. DAVIDSON used his 6.4 equatorial (by CLARK); and BURCKHALTER his 10½-inch reflector (by BRASHEAR). The satellite appeared black to both observers, until it was very close to the limb of *Jupiter* going off, when it rapidly faded, and was lost to sight. It re-appeared as a bright image, protruding from the edge of the planet, but having only one-sixth the brightness of satellite II. From the point where this bright image appeared it would seem that, in all probability, there was a broad dark equatorial belt on the satellite, with white poles, and this is in part sustained by a note in DAVIDSON'S observations wherein he thought the dark image was elongated, but the atmosphere at both stations was very unfavorable to sharp definition.

The phenomenon of the image of the satellite appearing black and white at the same time was observed by DAVIDSON at the transit of January 15, 1884, and illustrated in the "*Mining and Scientific Press*," of San Francisco, of March 15, 1884, after its presentation to the Academy. (And reprinted in the SIDEREAL MESSENGER, May 1884.

In these observations DAVIDSON found a power of 120 diameters, the best under the unfavorable atmospheric conditions, and BURCKHALTER used 215.

Barnard's new comet was readily picked up on the evening of July 10 with the 9-inch reflector, and was afterwards seen with the aperture reduced to four inches. Its approximate place at the time of my observation was R. A. 17 hours 15 minutes; Decl. south 6° 30′. It was faint and rather irregular in outline. The nucleus bright and flashing, and upon the side of the coma towards the *Sun*. It was also observed upon the 11th. On the 12th a faint short tail was detected and curious pulsations of light in the nucleus and coma were noted.

RED HOUSE OBSERVATORY, WILLIAM R. BROOKS.
July 15th, 1885.

The annual report of the Paris Observatory for 1884 is a document of unusual interest generally, but the feature of making star-charts and catalogues by photography is deserving of special notice. The aperture of the glass used in this stellar photography is 13.4 inches, and 11 feet and 3 inches focal length, giving a field of view of over three degrees. The sensitive plates on which the photographs are taken are about 10 inches square which would show a space of over five square degrees. An exposure of one of these plates for an hour showed 2,790 stars varying from the fifth to the fourteenth magnitude. The diameter of the 14th magnitude stars is said to be one thousandth of an inch. This is rapid work in getting magnitudes and star-places. It would require many months to do as much work in the ordinary way as photography promises to do in a single hour. It is gratifying to know that some of the leading observatories in America are giving attention to the study of this means of recording astronomical data, and early favorable results may be expected.

OCCULTATION OF ALPHA TAURI.

The occultation was observed at the Cincinnati observatory with the 4-inch equatorial, power 50.

	Mt. Lookout M. T.
Immersion July 8	15*h* 53*m* 17*s*.9
Emersion " "	16 46 46 .6

The disappearance was sudden; at re-appearance the *Sun* was already up and the *Moon's* dark limb could not be seen. On this account the emergence was difficult to observe, and the time noted may perhaps be as much as two or three seconds late. J. G. PORTER.

It is human to repeat some of the kind words that good people utter in the midst of the routine of common duties, especially if sparkling with sallies of wit or fun. We must be pardoned for clipping the following from a late letter from our distinguished friend C. PIAZZI SMYTH, Astronomer Royal of Scotland:—

"I have the pleasure of forwarding a post office order two years more subscription. I regret to say that the post office here is still in perfect ignorance of any other Northfield than one down in Virginia; so I have had to make out the order on St. Paul, Minn., in place of closer at hand to you. *Sic itur ad astra;* your ethereal journal soars upward to heaven, in the admiring gaze of all astronomers—while the bucolic popluations with their downward gaze on earthly things know nothing about it, nor about Carleton College, nor even Northfield City, Minnesota!

But your day of fame—and let us hope popular gratitude—will come."

STARS WITH LARGE PROPER MOTIONS.

In the zone observations which are being carried on at the Cincinnati observatory, working northward from 22° south declination, a number of stars have been found with appreciable proper motions. These will all be determined and discussed when the observations are sufficiently advanced.

The two following stars show such decided motion that it seems worth while to call particular attention to them:

LALANDE 20959. MAGNITUDE 7.5.

	Epoch	R. A.	Computed.	Declination.	Computed.
Lal.	1800	10h 47m 30.52s	30.65s	−20° 00′ 10.″7	10″.2
O. Arg.	1850	30.25	29.91	20. 0	21 .1
Brux.	1872	29.49	29.58	(29. 7)	....
Cin.	1885	29.27	29.39	29. 4	28 .7

The R. A. for 1872 is the mean of the Bruxelles' observations in 1869, 1872 and 1874. The declination was observed in 1869 only, and as it is evidently too large it has been rejected in the computation. The Cincinnati position is the mean of four observations. By least square we get

$\triangle\ \alpha = -0s.0148$ $\triangle\ \delta = -0''.21.$

The column headed "computed" gives the resulting R. A. and declination for the epoch of observation. ARGELANDER'S R. A. it will be seen, is quite discordant, but as a part of the trouble may lie in *Lalande's*. position, it was thought best to give equal weight to both. The total motion of the star in an arc of a great circle would be 30″.2 in a century.

LALANDE 24423.

	Epoch.	R. A. 1885.	Computed.	Declination 1885.	Computed.
Lal.	1800	13h .03m 29.52s	29.48s	−21°33′33″.2	33″.2
Bonn VI	1853	29.80	29.88	33 54 .3	54 .1
Bonn VI, Nachtrag	1867	29.96	29.99	33 57 .8	59 .6
Brux	1870	29.98	30.02	34 02 .6	00 .8
Cincin.	1885	30.24	30.13	34 06 .6	06 .7

The declination was observed at Bruxelles in 1869 and 1870, the R. A. in 1870 only. The Cincinnati position depends on two rather discordant observations. Giving equal weights we get

$\triangle\ \alpha = 0.0077s$ $\triangle\ \delta = 0''.395$ Total motion per century=40″.9.

J. G. PORTER.

By kindness of Secretary MATHEWS of Lick Observatory, six beautiful photographs of the late eclipse were sent us. The images are 1¾ inches with as perfect outline as we have seen. The thin crescent marking probably time of greatest obscuration has singularly perfect cusps. The numbers in a series of 74 taken during the eclipse, which we have received, are 2, 3, 24, 30, 45 and 69. We regret that the time of each photograph was not sent us that they might be published.

Spectra and Color of Stars.

In a report of Harvard College Observatory, recently published, Professor PICKERING speaks of work concerning the spectra and color of stars, as follows:

"Two separate series of investigations with regard to stellar spectra have been undertaken. It has been proposed to examine all stars known to have banded spectra with the object of approximately determining the positions of the bands in each upon a uniform system. This would afford means for a more definite and satisfactory classification than at present exists. The method of measurement consists in comparing the spectrum with a notched bar beside which it is placed in the field of the telescope. The proper position of the spectrum is secured by a previous reference to an image of the star formed by light allowed to pass beside the prism which forms the spectrum.

For the acquisition of more definite knowledge than at present exists with regard to the color of stars, it has also been proposed to observe all stars to the fourth magnitude inclusive, and north of the thirtieth parallel of south declination, with an instrument designed for the purpose. The spectrum of the star to be observed is properly placed in the field by the same means as in the other instrument just described. It is then carried by its diurnal motion behind a series of narrow bars placed at right angles to the spectrum, small portions of which are accordingly visible in the narrow spaces between the bars. The successive extinction of these portions of the spectrum is observed in a wedge of tinted glass. In this manner the relative brightness of definite parts of different spectra may be compared."

At the observatory of Pola, March 15, 16, 17 and 20 four observations of the new minor planet, No. 247 were secured.

Prof. CHARLES A. BORST, of Litchfield Observatory, assistant to Dr. PETERS, writing of Monday night's comet, says:

"At a little after 11 o'clock while standing with Dr. PETERS on the balcony of the dome where he was patiently waiting for the passing of some clouds which were an annoyance to his work, it seemed as if there was a flash of lightning, which made the horizon visible to us both in every direction. It lit up the earth as by a full moon; in an instant there was pessing before us a beautiful meteor, having a bright green light. In size it resembled *Jupiter* when under a power of three hundred diameters. It moued a little above Epsilon Virginis (*Vindematrix*), and apparently toward the north, being visible about five seconds, when it seemed to explode with a most brilliant display, resembling a sky-rocket. Looking by chance at the point in the heavens where it first struck our atmosphere, so intense was the light that it partially blinded the eye and caused the lids to close. The mind hesitated to believe that the green globe of fire was a meteor. The sensation was most peculiar, and can never be forgotten. It was as if the *Moon* were seen dropping into the lap of *Earth*.

But quickly are these fiery monsters checked in their course as the atmosphere catches them and reduces them to ashes, with as much ease as the spider traps and subdues the unsuspecting fly. The astronomer enjoys the beauty of the scene, and his monotony is relieved while humanity sleep on, having in the nature of things little to fear from dangers from which all are so well protected."—*Utica Daily Observer, July 8.*

Mercury and *Jupiter* were seen, at once, in the field of the telescope Juiy 20. 1883. *Venus* and *Jupiter* in the same way July 26, 1883.

The two planets, *Venus* and *Mercury* were seen together in the field of the telescope July 17, 1885, at 5 P. M. 75th medidian time. They were about 22 minutes of arc apart. At 9 o'clock the planets were only 11′ distant, but bad air prevented an observation.

BARNARD's comet was observed here July 11. It appears faint. I could see, at times, a distinct star-like central point.

July 14, seen again, and is more diffused, central point not seen.

Baltimore, July 14. J. R. H.

Mr. MANSILL, of Illinois, has, at last, relieved astronomers of all doubt about the existence of intra-mercurial planets. A single paragraph from a long article in a popular Canadian paper will show how he does it:

"I think it is unreasonable to expect another planet to exist between the *Sun* and the planet *Mercury*, for the following reasons: As all planets between *Jupiter* and the *Sun* must be large enough to turn by axial rotation a certain amount (much) of their equatorial surface before the *Sun* during a given time at (their) a certain distance from the *Sun*, or they (or any planet) must move through a greater amount of ellipticity in their orbits during the same given time, and on this account a very small planet could not exist between the *Sun* and *Mercury* for the further reasons that its increased density in moving so near the *Sun* would increase its orbital motion—and this would be apt to contract its volume in the same proportion. It therefore could not have so much equatorial surface to turn before the undulating electric action of the *Sun* during the same given time. Hence its path or orbit about the *Sun* would likely be somewhat longer, or lengthened into an elliptical form, or just in the same proportion to the amount of what its axial rotation may have been retarded.—*Advocate*.

O shades of astronomic lore!
From some dark Egyptian shore,
Save us, sure, from any more.

The following orders have not been previously acknowledged:

Professor S. P. Langley, Alleghany Observatory, (Vols. 3 and 4). Library of the University of Rochester, Rochester, N. Y. Samuel A. Boyle, Philadelphia, Pa. Ellen A. Hayes, Wellesley College, Wellesley, Mass. Royal Observatory, Greenwich Kent, England, (Vols. 1, 2, 3, 4). Royal Observatory, Cape of Good Hope, care of Trubner & Co., 57 and 59 Ludgate Hill. London, England, (Vols. 1, 2, 3, 4). Mr. Cruls, Director of Observatory Rio de Janeiro, Brazil, South America. Wm. N. Sage, Rochester, N. Y. D. Appel. Cleveland, Ohio, (Vols. 1, 2, 3, 4).

Professor T. C. GEORGE, University of the Pacific, San Jose, California, in a letter of recent date says:—

"We have just completed an observatory building in connection with our University, consisting of an octagonal room, 16 ft. across, in which is a brick pier 8 ft. square at the base and 22 ft. above the ground, and capped with a stone 3½ ft. square. Dome is 12 ft. in diameter inside, covered with galvinized iron and revolved with windlass, requiring only 15 lbs. to turn it, the track being of steel. On one side is a transit room 10 ft. by 12 ft. and 10 feet high; on the other the reception room, and over this the study."

The instruments are, a CLARK 6-inch equatorial with circles, a driving clock and micrometer, a transit by FAUTH & Co, costing $1000 and a chronometer.

The building and instruments are the gift of Capt. CHAS. GOODALL, of San Francisco, and DANIEL JACKS, of Monterey.

Professor GEORGE is to be congratulated that he has near him men of such spirit and generosity as this very liberal gift indicates.

Mr. JOHN R. HOOPER's observations of the occultation of *Aldebaran* by the *Moon*, at Baltimore, on the morning of the ninth of July, were as follows:

Immersion was instantaneous at	$4h\ 34m\ 17s$	75° Meridian Time.
Re-appearance, at	$5h\ 26m\ 35s$	
Duration was	$52m\ 18s$	

THE AUGUST PLANETS.

In 90th meridian time,

Mercury sets Aug. 5, 8*h* 29.5*m*, evening.
" " " 15, 7*h* 56.6*m*, "
" " " 25, 7*h* 09.6*m*, "

This planet is in conjunction with *Jupiter* Aug. 4th and 26th; in greatest elongation Aug. 5; in aphelion Aug. 6; in conjunction with *Venus* Aug. 8; with the *Moon* Aug. 11; stationary Aug. 19; is 1*h* 44*m* east of the *Sun* Aug. 1, and 9° 28′ south. It is visible to the naked eye.

Venus sets Aug. 5, 8*h* 40*m*, evening.
" " " 15, 8*h* 25*m*, "
" " " 25, 8*h* 9*m*, "

In conjunction with *Jupiter* Aug. 5; in conjunction with *Mercury* Aug. 8; the *Moom* Aug. 11; and Beta Virginis Aug. 19.

Mars rises Aug. 5, 1*h* 40*m*, morning.
" " " 15, 1*h* 31*m*, "
" " " 25, 1*h* 22*m*, "

The planet is 1° 20′ north of *Saturn* Aug. 6, and in conjunction with the *Moon* on the following morning.

Jupiter sets Aug. 5, 8*h* 40*m*, evening.
" " " 15, 8*h* 5*m*, "
" " " 25, 7*h* 30*m*, "

Except the dark transits of its satellite, *Jupiter's* physical features are uninteresting because far away and low in altitude.

Saturn rises Aug. 5, 1*h* 49*m*, morning.
" " " 15, 1*h* 14*m*, "
" " " 25, 0*h* 38*m*, "

And is in conjunction with the *Moon* Aug. 6.

Uranus sets Aug. 8, 9*h* 11*m*, evening.
" " " 16, 8*h* 40*m*, "
" " " 28, 7*h* 55*m*, "

Conjunction with the *Moon* the planet being 17′ north, Aug. 12, 18*h*, with *Venus* Aug. 23, 21*h*, the latter planet being 13′ north.

Neptune rises Aug. 8, 11*h* 19*m*, evening.
" " " 16, 10*h* 48*m*, "
" " " 28, 10*h* 1*m*, "

Conjunction with the *Moon* Aug. 1 and 31; is stationary Aug. 27.

Minor Planet (248) is the last discovered.

Aldebaran in *Taurus* will be occulted by the *Moon* Aug. 5, 2*h* 47.8*m*.

The new comet (BARNARD'S) is moving south-west and waning.

It is said by apparently good authority, that the best computation of the last contact of the late eclipse in New York differed from several good observations of the same by nearly half a minute of time.

ASTRONOMICAL PAPERS RECEIVED.

On the Right Ascensions of the Cape Catalogues for 1850 and 1880. and

On the Star Places of the Nautical Almanac, by A. M. W. Downing

Formulas for Computing the Position of a Satellite, by Asaph Hall.

The Great Comet of 1811, by Th. Bredichin. (French).

Bulletin of the Philosophical Society of Washington. Vol. VII.

Errata in July number page 152:

Line 16 of the table for −0′.09″.6 read +0′.09″.6.

Line 22 of the table for −1′.−07.″0 read −2′.07.0.

Line 26 of the table for 09.08*s* read 09.98*s*.

Line 31 of the table for −1′.17″.9 read +1′.−17″.9.

Line 36 of the table for −1*m*.25.45*s* read +1*m*.25.45.